THE GLASS INDUSTRY

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THE REPLACEMENT OF OXYGEN IN GLASS AND ITS EFFECT ON ADHERENCE

By WOLDEMAR A. WEYL

In recent work on the influence of additions of halides such as potassium chloride, bromide, and iodide on the fluorescence and color of glass, an interesting phenomenon could be observed. Mixtures of boric oxide and borax with addition of different coloring oxides were melted in a platinum crucible. After pouring out the melt the platinum was still covered with a layer of glass. On repeating the same experiment but adding potassium iodide, the melt could be poured out of the crucible without the slightest wetting, like mercury out of a glass container. Even if some of the melt was allowed to cool in the crucible, it came out in one piece and did not show the usual signs of adherence.

This phenomenon seems to be worth further attention as it might provide means of preventing the glass to stick to metal molds during pressing and blowing. Also, the casting of glass into metal molds becomes possible if glass to metal adherence can be sufficiently decreased. At the other hand, if replacing the oxygen by bromine or iodine decreases the wettability, other substitutions might influence it in the other direction.

The Nature of Adherence

The phenomenon of glass to metal adherence is very complex and cannot be covered by a single explanation. As studies concerning the gold ruby glass revealed,[1] the bond between noble metals and glass can be strengthened by introducing a heavy metal ion into the glass which produces residual valencies and which at the same time can assume positions like silicon. The tetravalent tin is an outstanding example. It not only forms SnO_4 tetrahedra but exerts strong chemical forces upon noble metals such as gold, silver, and copper. Zinc, bismuth, and cobalt behave much alike for they too can assume a position as a network forming cation and at the same time exert residual valence forces. There is no doubt that the role of cobalt oxide in ground coats is based at least partly on a similar effect. Only the blue cobalt glasses where the cobalt ion takes the place of silicon, forming CoO_4 tetrahedra, possess the quality of adhering to iron. Pink cobalt glasses, where the absorption spectrum reveals the presence of CoO_6 groups, do not exhibit the same quality.

But even without the presence of network forming cations like cobalt or tin, a certain metal to glass adherence is accomplished by the formation of oxygen bonds. All metals have a more or less pronounced tendency to combine with oxygen, and even such noble metals as platinum are covered with an oxygen layer. The role of oxygen in influencing the wettability of platinum by molten glass has been demonstrated by B. S. Ellefson and N. W. Taylor.[2] According to their observations, a droplet of molten sodium silicate wets platinum and expands on it provided the atmosphere contains oxygen. In vacuum or in nitrogen, the oxygen layer is removed and wetting is greatly impaired so that the molten silicate contracts again due to its surface tension.

Ways to Prevent Adherence

The practical problem of the sticking of glass to metal molds has recently been discussed by A. H. Dierker[3], who also pointed out the need for a better understanding of this phenomenon. The defect of sticking to a mold is due to the formation of metal oxygen bonds. Theoretically, it can be avoided in different ways.

1. Making the mold form a substance which does not possess sufficient chemical affinity to oxygen to form a bond. These materials are rare. Even noble metals such as platinum have enough affinity towards oxygen to cause sticking. Nevertheless, these possibilities have certainly not been exhausted, for no systematic experiments on the wetting properties of nitrides, borides, and carbides by glass are available.

2. Replacing the metal by a substance which does react with oxygen, but where the reaction product is a gas. This is certainly the oldest and most common solution of the sticking problem. In placing organic materials or graphite into the mold, a carbonaceous layer prevents the metal from forming a direct bond with the glass. The reaction product in this case is a gas, carbon monoxide and carbon dioxide.

3. Replacing the oxygen of the glass partly by iodine or bromine. Such a replacement of the divalent oxygen by a univalent halogen not only provides a weaker bond, but at the same time leads to a reaction product which consists of a volatile metal halide. As the experiments brought out, only a small amount of oxygen has to be replaced by iodine in order to obtain a noticeable effect. This method is certainly not the most economic or practical way for ordinary glass molding, but it might prove to be useful in special processes.

Possibilities and Limitations in Replacing Oxygen by Other Elements

With the increasing use of atomic models for demonstrating the structure of crystalline and vitreous silicates (B. E. Warren), the predominant role of the large

oxygen ion is easily impressed upon the observer. In the past our efforts to obtain glasses with new properties have been chiefly directed towards replacing the network forming cation silicon by boron, phosphorus, and germanium, or the network modifying elements sodium and calcium by other alkalis, alkaline earths, and similar elements. The possibilities of replacing oxygen have not yet been studied systematically. There are two principal ways of approach. From the viewpoint of the chemist, sulphur, which is closely related to oxygen, suggests itself as a potential substitute. From the structural point of view, fluorine seems to be more logical, for it has the same ionic radius and the same low polarizability as oxygen.

Replacement of Oxygen by Fluorine and Other Halogens

Replacing oxygen by fluorine leads to an interesting group of glasses. The crystal chemical properties of fluorine are very much like those of oxygen except that fluorine possesses only one valency, instead of two. This causes a weakening of the glass structure. The ionic radius of fluorine, however, is the same as that of oxygen and both anions are characterized by a low polarizability. So far as color and fluorescence are concerned, there is not much difference between a glass containing oxygen only and a glass containing a certain amount of fluorine ions. In the case of the iron color, fluorine offers a definite advantage in so far as it forms colorless iron complexes, thus improving the color.[4] The outstanding feature of fluorine is the weakening of the glass structure. Fluorspar has been used since centuries to decrease the viscosity of glass and slags. This use of fluorine became of new interest with the development of glasses low in alkali for metal vapor lamps.

Recently, W. Steger[5] used fluorine in glazes in order to develop a glaze free of boric oxide and lead oxide but still maturing at 1000°C.

Glasses where all oxygens are replaced by fluorine have been made by V. M. Goldschmidt[6] and their properties studied by G. Heyne[7]. The weakened structure of these glasses causes the coefficient of expansion to be extremely high ($200 - 260 \times 10^{-7}$) and the softening point to be extremely low. (160 - 300°C.)

Unfortunately, these glasses are water soluble, otherwise they would find application. They represent the only type of glass whose refractive index is lower than that of water.

Replacing part of the oxygen by chlorine, bromine, or iodine causes a pronounced change in the optical properties. These ions are very different from oxygen, but they cannot be introduced to high concentrations. Nevertheless, even small amounts have noticeable effects. W. C. Taylor[8] was the first to discover that their presence causes the light absorption of nickel and cobalt glasses to change. W. R. Brode[9] studied this phenomenon further, and with his knowledge of the light absorption of cobalt ions in different acids, he was able to interpret the color change. He found that the cobalt ion did not change its co-ordination, but finds itself surrounded by iodine rather than oxygen, which causes the color to shift from blue towards green and yellow.

Of interest is the color change which we noticed in introducing iodine into lead oxide or bismuth oxide containing glasses. There yellow and orange colors can be obtained due to the formation of lead or bismuth iodide.

The influence of these substitutions upon the fluorescence of glasses is not less interesting. Like in aqueous solutions chlorine, bromine, and iodine decrease or destroy fluorescence. By adding potassium bromide to glasses containing uranium or cerium their strong fluorescence can be quenched. Nonfluorescent yellow uranium glasses have been developed on this basis. At the other hand, addition of fluorides increases the intensity of fluorescence to some extent. The same series: $F < 0 < Cl < Br < I$ which has been found for the quenching of fluorescence of organic dyes seems to be applicable to glasses too.

For the manufacture of fluorescent glasses of high efficiency, the soda ash should be free of sodium chloride and the nitre free of iodine. Addition of fluorides at the other hand should prove beneficial.

The amount of chlorides, bromides, and iodides which can be introduced into glass depends upon its composition, the melting temperature, and the melting time, for these compounds are rather volatile. Like fluorides they possess a higher solubility at the melting temperature than in the softening range so that they might crystallize out of the glass on cooling or reheating. Their use as opacifier in lead glasses and lead-free glasses has been known, but does not yet seem to find practical application. Recently, Forst and Kreidl[11] used these opal glasses as base glasses for silver coloration and obtained red and purple colors instead of the usual yellow, brown and gray tints.

Replacement of Oxygen by Sulphur and Selenium

The tendency of some sulphides to form a glass on rapid cooling has been recognized by G. Tammann. The great polarizability of the sulphur ion in comparison with the oxygen ion and its tendency to form co-valent rather than ionic compounds make sulphides poorer glass formers than oxides.

The glass forming qualities of silica are based on its structure which is an extended three dimensional network of SiO_4 tetrahedra rather than of SiO_2 molecules. As V. M. Goldschmidt[6] pointed out, this is due to the ionic nature of the Si-O bond and the respective size of the silicon and oxygen ions which lead to tetrahedral arrangement. Replacing silicon by the smaller carbon or replacing oxygen by the larger sulphur leads to the compounds CO_2 and SiS_2 where the ratio of ionic radii makes the three dimensional tetrahedral arrangement unstable.

Silicon disulphide, the sulphur analogon of silica, is not a glass former, but its crystal structure consists of single long chain molecules rather than of a three dimensional network. Silicon disulphide has been obtained by Frémy (1852) by heating a mixture of silica and carbon in a stream of carbon disulphide vapor. Due to its molecular structure it volatilizes easily, whereas the oxide silica acts like a high polymer and has a very low vapor pressure.

With metal sulphides, SiS_2 forms sulpho- or thiosilicates, which too, crystallize readily so that their phase equilibria could be studied by means of heating and

cooling curves. Some of the thiosilicates have been studied by thermal and X-ray methods by Monselise[12].

The technical significance of the volatility of silicon disulphide for metallurgical processes has been recognized by A. Ledebur as early as 1870. F. Wüst and A. Schüller[13] explained the removal of sulphur from iron by the formation of volatile SiS_2 and SiS.

Due to the high affinity of aluminum towards oxygen, aluminum sulphide reacts with silica and silicates (E. Tiede and M. Thimann[14]) according to the equation:

$$2Al_2S_3 + 3SiO_2 = 2Al_2O_3 + 3SiS_2$$

Reactions of this type have been suggested and used to drive silica out of ceramic materials such as kaolin and zircon, in order to obtain pure alumina and zirconium oxide respectively. A comprehensive paper on the technical aspects of silicon disulphide and thiosilicates has been published by P. Dolch[15].

Hempel and Haasy[16] obtained the sulphur analogon of water glass, the sodium thiosilicate, by melting together sodium sulphide and silicon disulphide in a graphite crucible. These authors devised the method for the determination of thiosilicates in natural and artificial glasses which is based on their reaction with dry chlorine gas at elevated temperatures, leading to volatile $SiCl_4$.

Sodium thioborate glass $Na_2S \cdot 2B_2S_3$, the sulphur analogon of borax, has been used by W. R. Brode[9] in order to study the color change of a cobalt glass when oxygen is replaced by sulphur.

The stability of thiosilicate glasses, that is of silicate glasses containing a certain amount of oxygen replaced by sulphur ions, is greatly increased when zinc oxide is introduced. The zinc ions form the center of stable tetrahedra, the corners of which are occupied partly by oxygen, partly by sulphurs. The high heat of formation of zinc sulphide indicates that the sulphur zinc bond is relatively strong, whereas the strength of the sulphur silicon bond is only one-eighteenth of the silicon oxygen bond. The tendency of the zinc ion to combine and stabilize sulphur has been used by H. P. Hood to avoid the brown discoloration due to the formation of polysulphides when glasses have to be melted under reducing conditions[17]. Litzow and Brocks[18] found that no carbon amber can be developed in zinc-containing glasses. Not only the volatility of sulphur, but also that of selenium is decreased if zinc oxide is present in sufficient quantities. H. Weckerle[19], who studied the effect of zinc oxide in selenium ruby glass, found a straight line relationship between the amount of selenium retained in the glass and its zinc content. Due to the weakness of the sulphur silicon bond, in the absence of zinc most of the sulphur introduced will burn out as sulphur dioxide.

In the past, most investigations on the role of sulphur and selenium in glasses were concerned with colored glass. Recently, research on phosphate glasses, carried out by Kreidl and Weyl[20], revealed new possibilities of making colorless enamel ground coats. The high coefficient of expansion, the low melting point, combined with high acid resistivity and the variability in composition would make phosphate glasses particularly suitable for this purpose. Some of these glasses, however, have poor wetting properties. In certain phosphate glasses cobalt, nickel, and manganese oxide assume positions different from those in the structure of silicate glasses and accordingly do not promote adherence. The wetting and adherence of phosphate glasses, therefore, has to be increased by other means and the replacement of some of the oxygen by sulphur has been found to be a possible method. Such a replacement is much easier in phosphate glasses than in silicate glasses.

Alkali thioborates as well as thiosilicates easily hydrolize in the presence of water to form the borates or silicates and hydrogen sulphide.* They are unstable in aqueous solutions and the pure boron and silicon sulphides are readily attacked by moist air. Alkali thiophosphates, at the other hand, are relatively stable compounds. They can be re-crystallized from aqueous solutions and, as Zintl and Bertram[21] found, they precipitate a white crystalline lead thiophosphate from the aqueous solution of a lead salt. If lead oxide is introduced into a thiosilicate glass, black colors result from the formation of lead sulphide. Into a thiophosphate glass lead oxide can be introduced and stabilized by quenching. Only on reheating such a glass develops a black color. As the compostion of phosphate glasses can be varied over a wide range this black color can be produced at different temperatures. It is suggested to use these glasses as thermal indicators. Pigments which show such a sudden change of color within a narrow temperature range are used as paints to indicate if machine—or construction parts have exceeded a critical temperature.

Some glasses where oxygen is replaced by sulphur, selenium, or halogen, show the phenomenon of striking, that is, a development of color or opacity on reheating. The development of color in silver yellow, copper ruby and gold ruby glass is due to the growth of metal particles. The cadmium sulphide yellow and the selenium ruby glass is colorless when quenched, for it contains thiosilicates and thiozincates. The development of the color during the striking process is due to the formation of the yellow cadmium sulphide and the orange cadmium sulfoselenide. Both are covalent compounds and therefore possess colors, whereas the ions are colorless. This is not a mere growth of particles like in the gold ruby, but involves the breaking and forming of the strongest oxygen bonds in the glass structure. That is why silver yellow, copper and gold ruby glass can be struck below the softening range whereas the striking of the sulfide-selenide and fluoride glasses requires at least the mobility of the softening range.

Summary

The effect of the replacement of oxygen ions in glasses by other ions may be summarized as follows:

From the viewpoint of crystal chemistry, fluorine presents itself as a logical substitute for oxygen. Even chlorine, bromine and iodine are possible to a certain extent. They are so different from oxygen that such replacement causes striking changes in color and fluorescence and decreases metal glass adherence.

From the chemical viewpoint sulphur and selenium are possible substitutes for oxygen. The coloring properties of these elements have been known for some time and now their use for improving adherence and wettability is discussed.

(*Continued on page* 152)

THE FTC ELASTI-GLASS HEARING

S. Buchsbaum & Company of Chicago, manufacturers of various articles of men's accessories sold under the trade name of Elasti-Glass made further answer to the Federal Trade Commission's complaint that Elasti-Glass is not glass and does not contain glass, in a week's hearing which started March 16 in Chicago before Trial Examiner C. A. Vilas.

As previously reported in these columns the FTC has charged the Buchsbaum Company with misrepresentation of its products through the use of the name Elasti-Glass which implies that the product is made of glass or contains glass but in reality is made of Vinylite, a synthetic resin. The company has taken the position that Vinylite is a glass—a particular kind of glass—organic glass, and has presented at a previous hearing testimony by which it seeks to establish the truth of its claims. The Commission on the other hand has presented outstanding authorities in the glass field to substantiate its charge that Vinylite is not glass and does not conform to the commonly accepted definition of glass.

The respondent's witness at this hearing was Mr. H. F. Robertson of the Union Carbide and Chemical Corporation of New York which company supplies the basic material from which Elasti-Glass is made. Mr. Robertson qualified himself as an expert by stating that he is a member of the American Chemical Society and has been engaged in research in the field of synthetic resins since 1923. Because of his experience in this field, Mr. Robertson discussed at considerable length many types of synthetic resins which are sold under various trade names. His testimony along this line was very similar to that offered at a previous hearing on behalf of the respondent by Dr. Herman F. Mark. Mr. Robertson, however, has not at any time been engaged in the field of inorganic glass either from a commercial or experimental standpoint but stated that any experimental work involving inorganic glass was incidental to his research in connection with synthetic resins.

On examination by Mr. W. F. Moses, attorney for the respondent, Mr. Robertson stated that in his opinion the definition of glass formulated by the ASTM was too narrow in scope and implied that the definition was so worded by the Committee to further the interests of the inorganic glass industry and exclude so-called organic glass. Vinylite and some other synthetic resins are, in the witness' opinion, organic glass because they have a random arrangement of molecules and high viscosity which in his opinion are the main characteristics of the glassy state.

X-ray photographs of a specimen of Elasti-Glass were introduced into the record by which the witness attempted to prove that the substance was not in a crystalline state and in that respect conformed to the structure of inorganic glass. The witness then described in detail the method by which these X-ray photographs were made.

Having thus established that the structural conformation of Elasti-Glass was "random," charts were then introduced in an attempt to prove that the viscosity of the material in consideration, Elasti-Glass, was sufficiently high to justify it being termed "glass." The test for viscosity consisted of suspending a weight on a specimen of the material and observing its elongation at regular intervals by means of a cathetometer over a predetermined period of time which in this case was 18 hundred seconds. By plotting the results of this experiment, the witness arrived at the conclusion that after sufficient time had elapsed to exhaust the elasticity of the material, the viscosity was found to fall within the limits of his requirements for the viscosity of glass—10 to the power 8 poises. This power limiting value of viscosity was introduced into the evidence by Doctor Mark at the previous hearing.

The respondent then introduced a lengthy list of articles which had appeared in current periodicals and technical literature in an attempt to show that by common usage the word "glass" has come to denote substances other than inorganic glass. The witness was not examined, however, on this particular presentation at this hearing in order that the Counsel for the Commission might have an opportunity to go over the articles at a later date.

On cross-examination by Mr. Eldon Schrup, attorney for the Commission, Mr. Robertson identified numerous articles in common use, such as shellac, finger nail polish, etc., as "glass" with the qualifying statement, "if it has a random arrangement of molecules and high viscosity."

Mr. Schrup continued his cross-examination of the witness on the viscosity test and X-ray photographs but the responses were somewhat vague and of a highly technical nature and did not seem to have much bearing on the actual question under consideration. Mr. Robertson held to his ideas as to "what is glass?" through the entire cross-examination. Toward the end of the hearing, Mr. Schrup attempted to question the witness on his possible reactions if he were to make purchases of various articles made of glass. However, due to lack of time, this particular line of questioning was not pursued at length.

This foregoing testimony was, of course, of a highly technical nature as was the cross-examination by Mr. Schrup. To your reporter, it would seem that such evidence has very little, if any, bearing on the real issues involved in the case.

The hearing was adjourned to be reopened at a future date.

O-I ANNUAL REPORT

Plans for increased production for war needs in the plants of the Owens-Illinois Glass Company throughout the country were announced March 21 by W. E. Levis, chairman of the board of directors, in the annual report mailed to the stockholders. The report revealed that facilities of the company's shops in Alton, Ill., and Fairmont, W. Va., already are being utilized for war work. Plans have been completed to extend war work to certain other shops of the company. The company has also expanded its facilities for production og glass food containers to meet the increased needs of the country as a result of the war emergency.

A detailed financial statement showing 1941 net profits of $9,040,148, announced previously, and showing dividend payments during the year of $2.50 a common share, is included in the report. The profit amounted to $3.40 a share compared with $2.71 in 1940, when total net profit was $7,223,033.

A.C.S. PROGRAM OF PAPERS AND EVENTS

While Cincinnati does not seem to offer as many attractions to glassmen per se as other convention cities have done, the daily program of papers, social events and places of interest strongly indicates that glassmen who attend will find the meeting interesting, informative and pleasurable.

In addition to varied places of interest which can be visited in Cincinnati the social phase of the meeting will be highlighted by the usual President's Get-Acquainted Gathering and Dance to be held in the attractive Pavilion Caprice in the Netherland-Plaza Hotel Sunday night 9:00 P.M. to 1 A.M. Scheduled for Tuesday night during the same hours is the All-Out-for-Fun-Party. Dancing, floor show and a midnight supper in the Hall of Mirrors. For the ladies Mrs. M. C. Booze and Mrs. R. B. Caruthers have arranged a Ladies Holiday which will include Luncheon and Bingo Party for Wednesday afternoon at the Beverly Hills Country Club. Transportation to the Club will be furnished by the Local Committee. The Ceramic Camera Club will hold its Annual Dinner and Announcement of Prizes Wednesday evening 6.30 P.M. in Room H in the Netherland-Plaza.

Preceding the Presidents Get-Acquainted Gathering the Board of Trustees meeting is scheduled for Sunday from 9:30 A.M. to 1 P.M. Fellows Annual Meeting will follow at 2:30 P.M. The Business Meeting and Orton Fellow Lecture will begin at 9:30 A.M. Monday Morning. The first of the two War Emergency Sessions will take place from 2:00 P.M. to 4:30 P.M. on Monday.

On Monday the Board of Trustees luncheon is scheduled for 12:30 P.M. In the afternoon the Institute of Ceramic Engineers will meet at 4:00 P.M.

Under the chairmanship of Dr. J. T. Littleton a program of papers has been developed on War Emergency Problems. Since THE GLASS INDUSTRY was unable to present details of this program in its last issue paper titles, abstracts and time of meetings are presented in this article. Inasmuch as these papers on War Emergency Problems fall into the category of General Sessions they are not listed in chronological order with the Glass Division Meetings. Abstracts of Glass Division papers were given in the March issue of THE GLASS INDUSTRY. Following will be found the daily program.

GLASS DIVISION PROGRAM

Tuesday P.M.

(1) Properties of Soda-Silica Glasses at High Temperatures. *By Kuan-Han Sun, Nelson W. Taylor and Hurd W. Safford.*

(2) Expansion Characteristics of Corning 96 per cent Silica Glass No. 790. *By Howard R. Lillie.*

(3) An Apparatus for Recording the Movement of Interference Fringes. *By J. B. Saunders.*

(4) An Analytical Representation Concerning Glass in its Annealing Range. *By Arthur Q. Tool.*

(5) Sealed Glass Bushings. *By W. W. Grigorieff and C. M. Lampman, Jr.*

(6) An Investigation of Decay of Vibration Phenomena of Glass Bars. *By Joe G. McCann.*

(7) Structure of Sodium Borate Glass as Affected by Temperature. *By A. E. Badger and H. C. Johnson.*

Wednesday A.M.

(8) Is a Tank Crown Only a Roof Enclosure? *By L. S. Longenecker.*

(9) Effect of Iron Oxide on the Properties of Soda-Dolomite Lime-Silica Glasses. *Contribution of General Research Laboratory, Owens-Illinois Glass Co.*

(10) The Effect of Tin in Gold Ruby Glass. *By F. M. Veazie and W. A. Weyl.*

(11) Red Silver Glasses. *By Edward Forst, Jr., and Norbert J. Kreidl.*

(12) A Study of Photoluminescence in Glasses. *By A. R. Rodriguez and C. W. Parmelee.*

(13) Extinction Coefficients of Some of the Metallic Glass Colorants. *By R. H. Dows and S. R. Scholes.*

(14) A Study of Diffusion in Glass. *By J. A. Pask and C. W. Parmelee.*

Wednesday P.M.

(15) Precipitated Colorants Vs. Fired Colors. *By Alexander Silverman and Hurd W. Safford.*

(16) Fiberglas: Some Properties and New Applications. *By F. V. Tooley.*

(17) Effect of Various Alkalies in Glass on Electrical Conductivity. *By A. E. Badger and R. L. Cook.*

(18) Effect of Chemically Formed Surface Films on Glass Solubility. *By Frank L. Jones and Harold C. Hafner.*

(19) Studies Correlating Bottling Line with Pressure Test Breakage. *By A. Herman and H. M. Kindsvater.*

(20) Strength of Bottles as Affected by the Limitations of the Manufacturing Processes. *By F. W. Preston.*

(21) Instrumentation and Control of Glass Tanks. *By John R. Green.*

(22) The Parachor of Inorganic Liquids at High Temperatures. *By Kuan-Han Sun and Alexander Silverman.*

GENERAL SESSIONS ON WAR EMERGENCY PROBLEMS

Monday Afternoon, April 20, 1942:
2:00 P.M.-4:30 P.M.

1. Ceramic Production in the Time of War. *By Rexford Newcomb, Jr.: Bureau of Industrial Conservation, War Production Board, Washington, D. C.*

The author levels considerable criticism at the lack of product promotion on the part of the ceramic industry in the past, pointing out that other industries have been more successful in promoting poorer products owing to widespread advertising and aggressive merchandising.

A table of comparable properties of glass and porcelain is given, showing their relation to the more common metals and to some other non-metallic materials. A great number of suggested applications, wherein ceramic materials may displace metals and plastics, both in civilian and military production, is given.

2. What Enamelers Should Do About the War Emergency. *By F. G. Sutphen: American Rolling Mill Company, Middletown, Ohio.*

(*Continued on page* 147)

DEVELOPMENT AND TESTING OF NEW GLASS

at American Optical Company

(1) Behind American Optical Company's development of new glass lies a story of painstaking research and investigation which never really ends. The story begins in a library where Dr. E. D. Tillyer, AO research director (center), discusses with two of his assistants the properties desired in a new glass. Out of such conferences have been conceived many new and improved types of opthalmic glass which, after manufacture by glass producers, are transformed into lenses for the conservation and protection of life's most priceless heritage — vision. (2) Here you see a technician slip-casting crucibles of special physical and chemical characteristics for use in melting new glasses. These crucibles are especially suited, through control and selection of materials, to the glass exploration that has enriched millions of American lives.

1. A NEW GLASS IS PLANNED

2. MINIATURE GLASS POTS

3. MIXING AND WEIGHING

4. A NEW GLASS IS BORN

(3) Next step in the development of a new glass is the mixing and weighing of the ingredients for experimental melts. . The balance shown is sensitive to one-hundredth of a gram. This sensitivity is necessary because melts are made to weigh only a few ounces. (4) The ingredients of the new glass are next fused together in an electric furnace which can be brought to 2700°F. in less than two hours. The picture shows the melt being poured at white heat from the crucible into a graphite mold. After annealing, these discs are surfaced for measurement of optical properties. (5) Slender threads of glass (inset), drawn from an electric furnace, provide specimens for the determination of the softening temperature (see picture 6) and thermal expansion (see picture 7).

5. THREADS OF GLASS

6. *(Left)* SOFTENING POINT

7. THERMAL EXPANSION

8. VISUAL TRANSMISSION

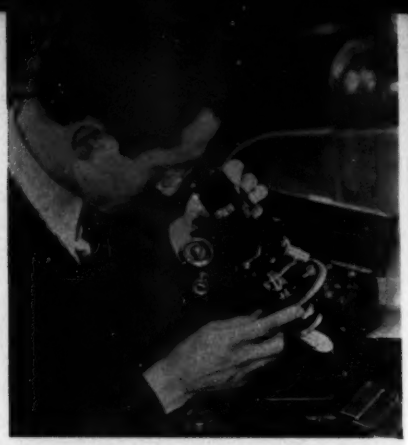
9. MEASURING COLOR

(6) For scientific purposes, and to guide the later lens manufacturing processes, the softening point of the threads is determined from their elongation under a controlled rate of heating. The apparatus used is the Bailey and Sharp adaptation of the Littleton technique. (7) Determining the thermal expansion curve of glass is accomplished in American Optical Company research laboratories with the aid of this instrument which automatically photographs the expansion of the glass from room temperature to its softening point and back again. This test is of prime importance in developing glasses for fused bifocal lenses, and it also gives invaluable data in regard to "fine" annealing temperatures. Tests like these, in the final analysis, determine the eye comfort and visual efficiency of millions who must wear eye-corrective lenses. (8) This picture shows a new absorptive glass—an exceptionally efficient invisible ray absorber —being measured with a specially equipped polarizing photometer, designed for checking light transmission of optical lenses. (9) This spectrophotometer measures the transmission of light for specific wave lengths throughout the color spectrum whereas the photometer in picture 8 integrates the light transmission over the entire visual region. (10) Vital to the development of absorptive glass which controls visible and invisible radiations is the testing of the glass to ascertain its absorptive properties. Shown in the picture is the instrument used to measure infra-red absorption. The electrical output of tiny thermocouples in the device operates a sensitive galvanometer which, by deflection of a spot of light, indicates the infra-red transmission of absorptive glass. (11) Here an AO scientist is measuring the ultra-violet absorbing properties of a glass by photographing through it a brilliant electric spark giving off invisible light radiation, thus recording the amount of ultra-violet transmitted.

10. MEASURING INFRA-RED

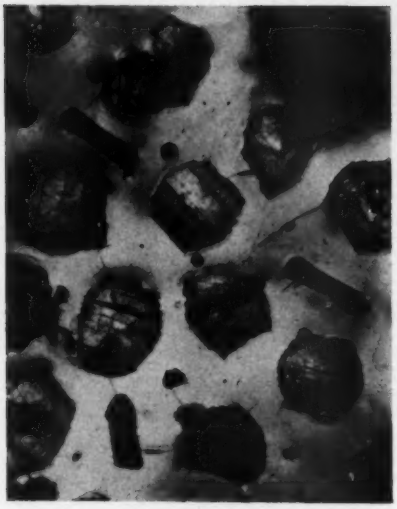
11. TESTING ULTRA-VIOLET

12. STRAIN RECORDER



13. PETROGRAPHIC STUDY

14. CRYSTALS



15. GLASS RECORDS

(12) Here a glass technologist sets the camera in an automatic strain recording machine, designed and built by AO to test glass samples for fused bifocals (lenses used for both near and distant seeing). Each of AO's opthalmic glasses must fuse with every other one and the device shown photographs the type and amount of any strain present from fusing temperature to room temperature. (13) In developing new, unusual glasses, strange types of devitrification frequently show up. The picture shows a glass technologist examining a thin section of such a glass with the aid of a petrographic microscope, an instrument made by the Spencer Lens Company, scientific instrument division of AO. (14) Here's a photomicrograph of the crystals formed in an experimental glass, as seen through the petrographic microscope shown in picture 13. (15) Specimens from each of the experimental glass melts made by AO scientists over many years are filed away in these cabinets. Annually more than a thousand melts are made in the search for better glass.

17. EYESIGHT EXAMINATION

16. LENSDALE AT NIGHT

(16) Shown here is Lensdale, one of American Optical Company's enormous lens plants, where glasses developed through AO research are transformed into lenses. Because of the emergency, Lensdale is now being operated night and day to supply the tremendous demand for lenses of various types on the part of the Government, national defense industries and the optical profession. (17) Obviously, lenses for the correction of eyesight are valueless unless they interpret exactly a prescription for the correction of a specific eye condition. For this reason the eye examination is extremely important in correcting defective eyesight, a point overlooked by many people. It should be remembered that glasses are merely therapeutic devices, prescribed in the rendering of a professional service.

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During February

Compositions

To the surprisingly large number of recent patents on fused silica, James F. Hyde of Corning N. Y. (Corning Glass Works) has added another which concerns the use of unique batch materials. In this latest patent, 2,272,342 the vapor of a silicon salt such as silicon tetrachloride is atomized into a high temperature burner to give an extremely finely comminuted form of silica which is readily vitrified at comparatively low temperatures. It may be collected in an electrical precipitator of the Cottrell type or it may be deposited by one burner on a molding form and immediately vitrified by another burner. The silicon compounds suitable for these processes are those which will readily hydrolyze such as silicon fluoride, and ethyl silicate. The subject matter of this patent is similar to John A. Heany's patent 2,268,589 discussed in the March 1942 GLASS INDUSTRY.

Furnaces

In patent 2,272,217 illustrated in Fig. 1, L. S. Longnecker of Pittsburgh describes a melting furnace which disposes with the usual dog house at the charging end. The furnace tank and the bath of molten glass extend outwardly beyond the roof of the furnace, and the glass batch is fed onto this extended glass surface. Apparently this is the first of three patents concerned with this radical departure in furnace design. Two pending applications referred to in this patent have been filed by H. L. Halbach, W. G. Koupal and William Owen. Mr. Longnecker's patent is concerned primarily with the construction of the wall, which as shown in Fig. 1, has a horizontal section which serves as a low level roof for the tank extension. This roof section is kept at a high enough temperature to frit or sinter the batch before it moves into the melting chamber, so that a minimum of dust will enter the furnace. The wall is vertically adjustable by threaded rods 74 which support it.

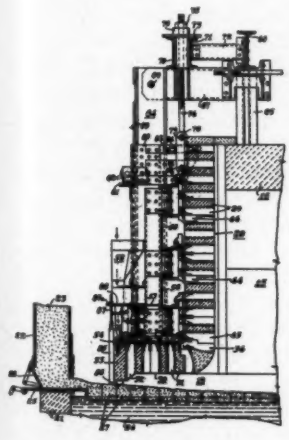


Fig. 1. 2,272,217: Longnecker. Melting furnace in which the hearth is carried beyond furnace wall to sinter the charge before it enters the furnace.

Feeding, Forming and Shaping

One of the two February patents granted to Walter K. Berthold of Rockville, Conn. (Hartford-Empire) is 2,273,777 which describes modifications of the "narrow neck" method of forming bottles in machines of Hartford type. Although the series of illustrations which is included in the patent is needed for a full understanding of the principles, it might be mentioned that after the gob is compacted downward to shape its neck in the blank mold the counterblow forces the glass up against a baffle plate of novel design which forms the bottom of the blank. This baffle has a recessed cavity of such contour as to constitute an upward continuation of the mold cavity and to avoid any angular recess or corner at the juncture of the mold cavity and the baffle. The baffle is next removed and a slight blow is exerted to cause the glass to stand free from the top edge of the mold. Then the halves of the blank mold are opened and the blank or parison, still supported in inverted fashion by the neck mold, is given an additional blow before it is transferred to the final blow mold.

Fig. 2 shows a machine invented by Charles G. Anastor of Vineland. N. J. (2,272,105, Kimble Glass Co.) for forming pairs of bent tip medicine droppers from glass tubes which have previously been flared at the bulb-receiving ends. The flared tubes are automatically selected from a supply magazine by the fingers of a conveyor chain which holds them in spaced positions. They are carried over a series of burners 49 which heat their mid-sections so that they will readily form a neck when that portion of the conveyor is reached where a drawing or stretching device engages the flared ends of the tubes. At a station shown between 47 and 48 in Fig. 2, an arm on a rotating shaft picks up each tube from the conveyor and serves as a shaping form since the tube is then soft enough to bend by gravity to the shape of the support. The blanks thus take a substantial V-shape with the apex being regularly curved. They are cooled adequately to maintain their shape before removal from the machine, and thereafter need only to be severed to complete the formation of the pair of droppers made from each blank.

Patent 2,274,105 granted to Andrew H. Stewart of Shields, Pa. and Peter Kucera of Allison Park, Pa. describes their method of controlling the cooling and shrinkage of molded glass articles having optical sur-

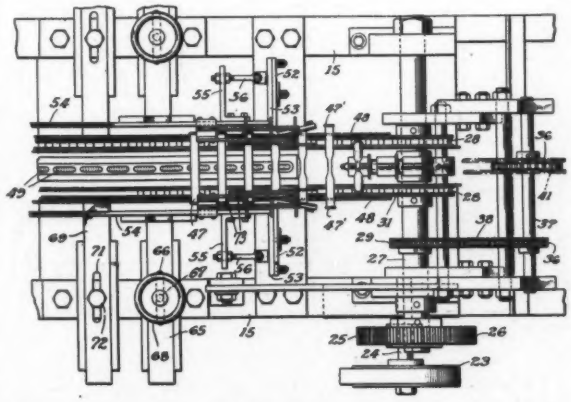


Fig. 2. 2,272,105: Anastor. Machine for making medicine droppers from flanged tubes. When burners 49 soften the tube centers they are kept from collapsing by weighting fingers 73.

faces, by means of a reservoir of hotter glass in the main section of the blank.

Miscellaneous Processes

An uncommonly large number of patents on lamp working processes were issued during February. Four of them, assigned to Westinghouse Electric and Manufacturing Co., were 2,273,437 granted to Thomas R. Dunn of Bloomfield, N. J., and 2,273,439 to George A. Freeman of East Orange, N. J., both for methods of sealing conductors to quartz tubes; and 2,273,441 to Daniel S. Gustin of Bloomfield, N. J., and 2,273,445 to M. E. McGowan and Richard A. Rehberg of Bloomfield for methods of sealing glass bulbs.

Other contributions to the lamp working are were patent 2,273,488 granted to Emil Hofman of Newark, N. J. (Chemical Products Co. of N. J.) for a method of sealing electrical conductors to fused quartz tubes, and 2,272,747 granted to Albert W. Hull and Louis Navias of Schenectady (General Electric) for another type of glass-to-metal seal. The latter inventors find that the following glass compositions have expansion rates (See Fig. 3) suitable for sealing to iron:

	A.	B.	C.	D.
Silica (SiO_2)	45%	45%	45%	45%
Potassium Oxide (K_2O)	14	12	12	14
Sodium Oxide (Na_2O)	6	6	6	6
Lead Oxide (PbO)	30	32	29	10
Barium Oxide (BaO)	—	—	—	20
Calcium Fluoride (CaF_2)	5	5	5	5
Boric Oxide (B_2O_3)	—	—	3	—

Patent 2,272,919 (Western Electric Co.) granted to Carl W. Maurer of Freeport, N. Y. and Arthur E. Winey of Plainfield, N. J., describes an annealing apparatus integral with and surrounding a machine in which stems for vacuum tubes and lamps are formed.

Luke L. Stager of Arlington, N. J., has assigned to Western Electric Co. his patent 2,272,927 for a method of "tubulating" a glass bulb. In this process wherein it is desired to attach a glass tube to the globular end of a lamp bulb, the steps are, (1) to set up the work so that the end of the tube bears on the bulb, (2) to heat this section by a burner inserted into the bulb, (3) to move the tube slightly into the softened glass bulb while applying air pressure through it to break the softened glass against the flame, and (4) then to continue

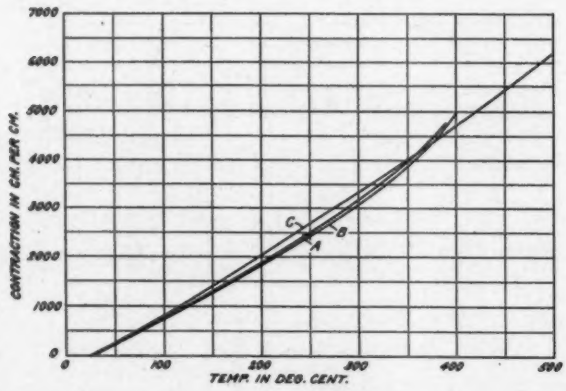


Fig. 3. 2,272,747: Hull and Navias. The contraction curve C of iron is essentially duplicated by lead-silica glasses A and B.

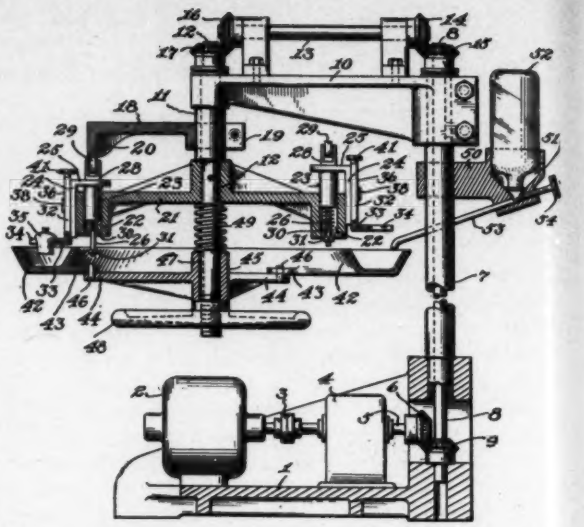


Fig. 4. 2,272,586: Ross. Decorating device in which articles 35 are dipped in ceramic colors held in a trough which rotates with the ware.

the flame action long enough to fuse the flared section smoothly against the bulb.

To increase the chemical durability of glass containers sulphur pellets are introduced into bottles before they are annealed, and other chemical substances have also been suggested. Now Walter K. Berthold of Rockville, Conn. (Hartford Empire) announces in patent 2,273,778 that similar improvement (without the disadvantages occasioned by the use of chemicals which require washing for removal of residues) can be obtained by merely treating the bottles with steam. The preferred method is one of using the steam to blow the glass to final form and then using dry air to drive out the residual moisture before annealing the articles. Mr. Berthold advances no theory as to why the steam has the reported effect on durability. There is no obvious analogy to the action of sulphur which is believed actually to remove some alkali in the form of sulphates from the glass surface. A claimed advantage for the steam process is that it forms no deposit or "bloom."

Fig. 4 is taken from patent 2,272,586 in which James W. Ross of Washington, Pa. (Hazel-Atlas) describes an apparatus for decorating glass articles by dipping them in paint. The machine has a circular head piece which supports the ware 35 above a paint trough 42 which rotates at the same rate as the ware support. Thus when the individual supports dip the ware in the paint there will be no relative horizontal movement of paint and ware. The paint is kept stirred by a stationary agitator which does not appear in Fig. 4.

Lens manufacture is dealt with in patent 2,272,119 granted to George Jaeckel of Berlin-Lichterfelde and assigned to the firm of Sendlinger Optische Glaswerke G.m.b.H.

Sheet and Plate Glass

Apparatus for polishing glass sheets was disclosed in patents 2,272,729 granted to Eugene P. Searing of Paterson, N. J., and 2,272,651 to Frederic B. Waldron and James H. Griffin (Pilkington Bros. Ltd.).

For cutting glass sheets into strips or plates, Raoul J. Louviaux and Arthur W. Goralske of Toledo (2,273,716, Libbey-Owens-Ford) provide a cutting table with a top pad, possibly made of rubber, which has V-shaped grooves for receiving particles of glass resulting from the cutting operation.

In another Libbey-Owens-Ford patent, Ormond H. Paddock of Rossford, Ohio, (2,273,733) uses a latex paste for sealing the two panes of a double walled glass unit such as those sold under the brand names Thermolux and Thermopane. A suitable composition for this sealing paste which is used to keep dirt out of the units follows:

Dry rubber	68.45%
Water	30.
Ammonia	0.05
Natural proteins	0.8
Caustic alkali (KOH)	0.7

Glass Wool and Fiber

Carlton C. Davies of Wabash, Ind. (2,274,130, American Rock Wool Corporation) has patented an apparatus for spinning mineral fibers by a centrifugal process by which spinning discs, which dip into molten material, throw the fibers from their periphery. The rims of the discs are cupped or indented to increase their capacity for retaining the molten material.

Patent 2,271,829 granted to Milton A. Powers of Detroit describes a number of procedures for making insulating slabs or block from mineral or glass wool, by sintering a mass of wool until it is just short of fusion and then applying pressure to compact it. Such processes are of commercial interest since they provide a means of making a relatively stiff fiber board.

Allen L. Simison of Newark, Ohio (Owens-Corning Fiberglas Corp.) has received patent 2,272,588 for a means of treating glass fibers which facilitates their fabrication into packages, twisted yarns or cables and interwoven fabrics. In drawing extremely fine continuous fibers as by the Slayter-Thomas process of patent 2,234,986 the speed of attenuation and production of fibers is limited by the speed at which the fibers can be formed into strands and wound on packages in such a manner that the strands can be unwound and processed in conventional textile machines. Simison groups the fibers into a strand at a point between their source and the package on which they are wound, and at this point coats them with a molten wax capable of solidifying, solely by cooling, within the small fraction of a second before they reach the package. The waxes are applied at about 120° F to 190° F. They may include paraffin wax, carnauba, bees wax, and many others. It is best to use one which is slightly plastic but not soft or tacky at room temperature. One of the advantages of the process is that the wax holds loose fiber ends in place and prevents fuzz.

After the strands have been fabricated into the finished product such as cloth, the wax may be removed by washing the fabric in a soap solution.

Glass Blocks

John L. Drake of Toledo assigned to Libbey-Owens-Ford Glass Co. his patent 2,272,061 for a building block composed of two sections of glass joined at edges which are coated with colored ceramic enamel, which is visible through the walls. The inner surfaces of the block may be similarly colored.

To form a block from cellular or frothed glass, Henry R. Black of Corning, N. Y. relates in patent 2,272,930 that he pours a charge of glass into a mold and then forces steam or another gas through a porous bottom section to produce the frothing and blow the glass up to fill the mold. A principal feature of the invention is the provision of a metallic insert near the bottom of the mold to cool and give a crust to the glass before it is frothed to the top.

RESEARCH FELLOWSHIPS

The University of Washington offers four fellowships in the College of Mines for research in Coal and Non-Metallics in cooperation with the United States Bureau of Mines. Fellows begin their duties on Wednesday, July 1, and continue for 12 months. Payments under a fellowship are made at the end of each month and amount to $792 for the year.

The purpose of these fellowships is to undertake the solution of various problems being studied by the United States Bureau of Mines that are of especial importance to the State of Washington, the Pacific Northwest, and Alaska. The investigations consist principally of laboratory work directed largely by the Bureau's technologists.

These fellowships are open to graduates of universities and technical colleges who are qualified to undertake investigations of research character. Ordinarily the appointees register as graduate students and become candidates for the degree of Master of Science in Mining, or Metallurgical, or Ceramic Engineering. Further details may be obtained from Milnor Roberts, Dean, College of Mines, University of Washington, Seattle, Washington.

CULLET MAKER—1942

The Home Guard in the Southern Command area (England) attends a school where they undergo the most intensive training in the latest warfare and weapons, one of which is shown in this picture; loading a fire bottle and charge into a Northover Projecture. This device is a great improvement on lobbing by hand, throwing various types of missiles—fire bottle, grenade, smoke bomb, etc., with force and accuracy.

CURRENT STATISTICAL POSITION OF GLASS

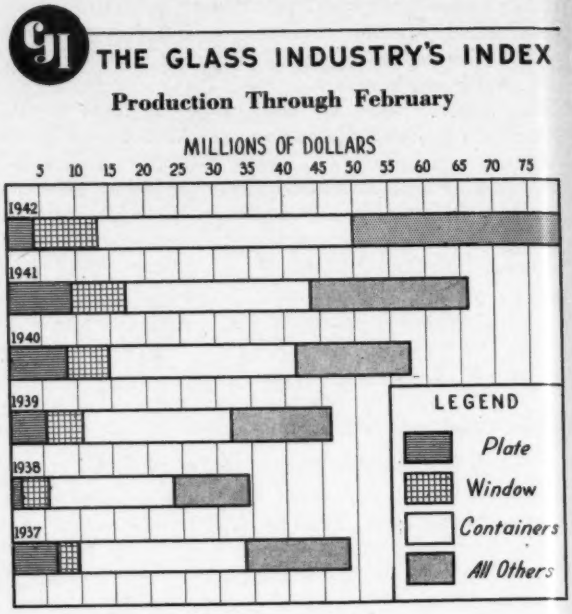
During February the glass industry set new records for this period of the year; production, employment and payrolls continued at an exceptionally high rate. According to THE GLASS INDUSTRY's Production Index, output during February was valued at $38,000,000 as compared to $32,000,000 in February 1941. During the first two months of this year production was estimated at over $80,000,000—27 per cent ahead of last year.

Plate glass production during February totalled 5,600,379 square feet according to the Plate Glass Manufacturers of America. This represented a decline of 38 per cent from the January figure and was 65 per cent less than last year's comparable total. During the first two months of 1942 plate glass output amounted to 14,743,362 square feet as compared to 35,014,000 square feet last year—a drop of 58 per cent.

Window glass output during February amounted to 1,456,744 boxes which was a decline of 10 per cent from the January figure but exceeded the February 1941 total by 3 per cent. During the first two months of 1942 this production amounted to 3,095,454 boxes or 2 per cent greater than in 1941's comparable period. The industry operated at 89.7 per cent of capacity during February.

Glass container production during February totaled 5,965,434 gross, according to the Glass Container Association of America. This was 10 per cent less than the January total but exceeded February 1941 by 36 per cent. During the first two months of 1942 glass container output amounted to 12,719,949 gross as compared to 8,885,000 gross in 1941—an increase of 43 per cent.

Shipments of glass containers during February totaled 6,140,559 gross or 44 per cent more than the February 1941 volume. Outstanding gains were reported over last year's corresponding month for domestic fruit jars and jelly glasses which were produced in a volume 10 times greater than last year, and for beer bottles which increased 266 per cent. Sales of narrow neck food containers were up 64 per cent, wide mouth food jars 43 per cent, pressure and non-pressure ware 42 per cent, liquor ware 35 per cent, general purpose ware 22 per cent, medicinal and toilet ware 20 per cent and milk bottles 13 per cent. Cumulative figures for the first two months of 1942 reveal that shipments during this period were 42 per cent greater than last year. Domestic fruit jars increased 677 per cent, domestic jelly glasses 416 per cent, beer bottles 280 per cent, narrow neck food containers 51 per cent, pressure and non-pressure ware 48 per cent, liquor ware 44 per cent, wide mouth food containers 32 per cent, medicinal and toilet ware 24 per cent, general purpose ware 21 per cent, milk bottles 19 per cent.



Inventories of glass containers at the close of February were at about last year's level. The increases in some lines were offset by decreases in narrow neck food containers, pressure and non-pressure ware, beer bottles and general purpose ware.

Miscellaneous glass products manufactured during February had a value of $15,000,000 as compared to $11,000,000 in last year's corresponding month.

CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS)

Types of Ware	*Production*		*Shipments*		*End of Month Stocks*	
	Feb. 1942	*Feb. 1941*	*Feb. 1942*	*Feb. 1941*	*Feb. 1942*	*Feb. 1941*
Food Containers (Narrow neck, wide mouth, and pressed)	1,522,674	1,153,335	1,707,040	1,149,402	2,246,230	2,094,170
Pressure and Non-Pressure	471,325	384,029	408,395	274,856	745,630	1,004,312
Beer	575,938	270,291	600,589	166,529	375,657	801,767
Liquor	846,605	572,857	916,560	674,755	1,768,194	1,625,715
Medicine and Toilet	1,772,785	1,438,843	1,740,869	1,433,065	3,422,036	3,118,317
General Purpose	416,969	307,992	428,948	351,425	503,584	622,346
Milk	225,431	197,293	223,664	198,655	372,480	296,835
Fruit and Jelly	115,952	22,586	96,926	7,749	521,280	497,308
All Other	17,755	16,420	17,568	13,541	45,479	36,407
Total Industry	5,965,434	4,363,646	6,140,559	4,269,977	10,000,570	10,097,177

Manufacturers sales of machine-made table, kitchen and household glassware during February totaled 3,111,639 dozens which was 7 per cent higher than last year. During the 12 months ending February 28, 1942, sales of this ware amounted to $39,563,438 dozens or 20 per cent greater than in the previous comparable period.

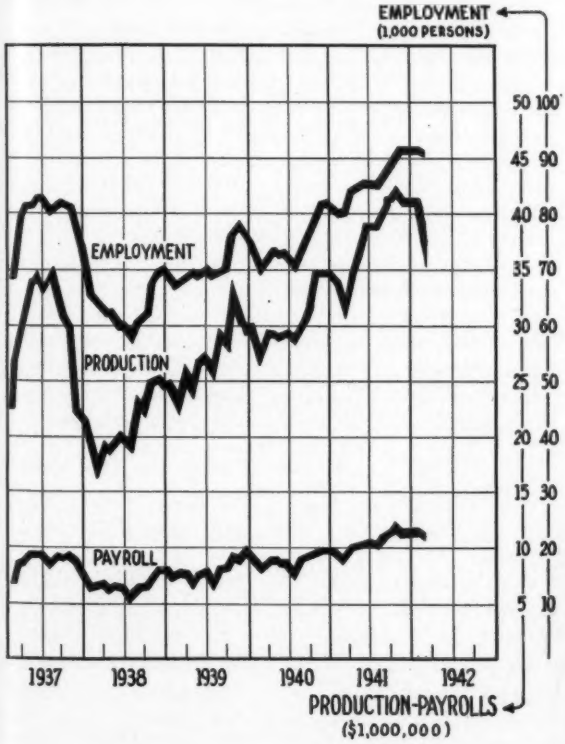
According to a preliminary report of the Census Bureau, 12 illuminating glassware manufacturers reported February sales totalling $716,000 which was 6 per cent over February 1941 but 5 per cent less than the January 1942 total.

Employment and Payrolls: Employment in the glass industry during February dropped to 92,000 persons according to preliminary estimates; this compares with 93,000 persons in January and 80,300 persons in February 1941.

Payrolls in the glass industry during February are estimated at $11,000,000 as compared to $12,500,000 in January and $9,000,000 in February 1941. Glass manufacturers paid out over $33,000,000 in wages during the first two months of 1942 as compared to less than $19,000,000 in last year's corresponding month.

GJI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through February, 1942



· Buy Defense Bonds ·

A.C.S. PROGRAM

(*Continued from page* 139)

3. Post-War Planning. *By Alexander Russell Stevenson, Jr.: General Electric Company, Schenectady, N. Y.*

4. The American Way. *By Bennett Chapple: American Rolling Mill Company, Middletown, Ohio.*

5. Indian Kyanite and Possible Domestic Replacements. *By Hewitt Wilson: U. S. Bureau of Mines, Electro-technical Laboratory, Norris, Tenn.*

A progress report is presented on the changes produced by heat in the physical properties of kyanite and topaz. High-temperature load-test comparisons of commercial and laboratory brick made of mullite-producing materials are described.

Tuesday Forenoon, April 21, 1942: 9:30 A.M.-12:00 N.

6. Beneficiation of Domestic Talcs for Production of Talc of Radio Porcelain Grade. *By R. G. O'Meara: Southern Experiment Station, U. S. Bureau of Mines, Tuscaloosa, Ala.*

A survey has been made of the talcs obtained from various producers and from different deposits.

7. Notes on Constitution of Steatite. *By H. Thurnauer and A. R. Rodriguez: American Lava Corporation, Chattanooga, Tenn.*

A brief survey of the literature on the crystal structure of calcined talc and steatite materials is presented. The changes in the structure of talc and steatite bodies brought about by varying heat-treatment and by the addition of different fluxes were studied. The moisture absorption changes were determined after autoclaving the test specimens in conjunction with microscopic and X-ray studies. Great differences in the rate of crystal growth and extent of polymorphic transformation of one magnesium metasilicate modification into another were observed in the different bodies.

8. Development of Topaz as Source of Alumina. *By Blandford C. Burgess: United Feldspar & Minerals Corporation, Minpro Division, Spruce Pine, N. C.*

9. Symposium on "Ceramics in War Emergency."
Enamel Division: Charles S. Pearce: Secretary, Porcelain Enamel Institute, Washington, D. C.
White Wares Division: Robert F. Sherwood: United Feldspar Corporation, New York, N. Y.
Refractories Division: Louis J. Trostel: Research Laboratory, General Refractories Company, Baltimore, Maryland.
Glass Division: T. J. Thompson: Corning Glass Works, Corning, N. Y.
Structural Clay Products: Harry C. Toummer: Structural Clay Products Institute, Washington, D. C.
Materials and Equipment Division: J. E. Eagle: Vitro Manufacturing Company, Pittsburgh, Pa.

R. B. TUCKER TO BOARD OF DIRECTORS

R. B. Tucker, director of glass sales of the Pittsburgh Plate Glass Company, has been elected to the board of directors of the Company, succeeding H. A. Galt of Akron, Ohio.

Mr. Tucker has been associated with Pittsburgh Plate Glass Company since 1929 when he was appointed manager of glass sales.

Research Digest

Practical Interpretations of Glass Technology

Cords

The paper presented by W. B. Silverman of the Research Laboratories, Owens Illinois Glass Company, at the Hershey meeting of the Glass Division, September 1940, has recently been published in the *Jour. Amer. Ceram. Soc.* (March, P. 168). Mr. Silverman has produced cords synthetically by laying a fiber of different composition upon a blank of cord-free glass. He then heated the blank to a bright yellow (1240°C) sometimes for a few minutes, again for several hours, and inspected the "cord" to determine its relative persistence.

In selecting the physical reason for the persistence of the "cord," Mr. Silverman gave particular attention to surface tensions of the two glasses. When the glass of the fiber had a surface tension higher than that of the matrix glass, the cord persisted. If the cord had a lower surface tension, it disappeared quite readily. Viscosity seemed to have very little influence.

Those oxides which operate to increase the surface tension of glasses might be expected in the light of these experiments to be responsible for cord formation. In the experiments described, this was indeed the case. When alumina and lime in particular were present in relatively high amounts in the fiber glass, it would not flatten out but remained as a definitely visible cord. This work corroborates the suggestion of Jebsen-Marwedel (1937). It also corroborates opinions formed on the basis of careful analytical work, and prevalent among glass chemists.

However, these results are not entirely in agreement with the findings of J. C. Turnbull, who applied the method of separating heavier and lighter portions of pulverized cordy glass, by means of centrifuging in a heavy liquid under thermostatic control. Subsequently, the separate portions were analyzed and the smalled fraction, naturally assumed to be the cordy one, was often lighter and was also found upon analysis to contain a higher proportion of silica. The conclusion was naturally reached that at least some cords are of silicious origin.

The glassmaker is left somewhat confused by these conflicting reports. He may well feel uncertain as to whether any local inhomogeneity in the depths of the glass may behave as it would upon the surface, as in Silverman's experiment. He may feel that gravity itself has something to do with the flattening out and disappearance of the artificial cord produced by laying a fiber upon a glass plate, whereas deeply immersed in the glass, the cord would have no such assistance in its dispersion.

In connection with the Turnbull experiments, the glassmaker might question whether or not the right fraction had been selected as the one responsible for the cords. It is to be expected that the particle size of the material introduced into the heavy liquid in Turnbull's centrifuge was small enough so that a single particle might contain nothing but glass of the cord. On the other hand, it is conceivable that a single particle might contain samplings, not only of the cord composition, but of the glass immediately surrounding.

The Turnbull method does not lend itself easily to reproduction in the average laboratory because of the highly specialized equipment required, to say nothing of the skill necessary in conducting the separations. It is to be hoped that continued work will be done and further reports issued by the Preston laboratory, so that further corroboration of the findings may be had if possible. Silverman's experiments apparently involve no such difficult technique, and it would be highly desirable if that work could be repeated by other investigators.

It is not impossible for the glassmaker to believe the results of both sets of experiments. That is, the local concentrations of glassy liquids not corresponding in composition with the parent glass must be reluctant to diffuse and thus to enter into complete and homogeneous solution with the latter. Cords may very well be incapable of classification in terms of responsible oxides.

It remains for the glassmaker to take every precaution as to the grain-size of his raw materials, the mixing operation, adequate high temperature in the furnace on one hand, and the avoidance of extreme refractory attack on the other.

These remain as harmful agents segregation of the batch after mixing, and the tangible and only partly understood currents in the tank, which may bring into circulation glass which has for a long time remained in stagnant contact with the bottom or walls.

If alumina and lime or other oxides leading to high surface tension are actually responsible for most of the cords, they may not be eliminated from glass compositions on this account. One may only take pains that they are introduced in such a way as to be completely dispersed into the glass as a whole. If silica is the oxide responsible for at least some of the cords, it can by no means be eliminated or even much reduced, but the glassmaker can pay more attention to his sand and to the manner in which it is mixed with the fluxes.

All this is not intended to deny the value of the experiments under discussion as means of diagnosis, which must always precede any attempt to find a cure. However, in this instance, one could wish that the diagnosing physicians were in better agreement, and the offending "organs" did not involve such essential parts of the patient's anatomy that their elimination becomes impossible.

• E. C. Bowers, President of the Wickwire Spencer Steel Company, has announced the appointment of Gordon L. Crawford, previously sales manager of the Buffalo district, as Assistant General Sales Manager with headquarters in New York. Mr. Crawford will continue as sales manager of the company's structural products division.

WANTED—Glass Factory Sup't capable of taking entire charge of factory producing bottles, tumblers, jars, etc. Mechanical engineer preferred who has experience in operating Hartford-Empire feeders, I. S. Machines and Lehrs and familiar with Hartford "62" Process operation. Factory located in South America. Applicant must consider position as permanent. State age and experience. Box 49, The Glass Industry, 11 West 42nd Street, New York City.

NEW EQUIPMENT AND SUPPLIES

MODEL 30 STABILOG

When the Foxboro Company introduced the Stabilog Controller some years ago, it was featured as the first instrument providing full proportional control with automatic reset of the control point. In introducing the new Model 30, Foxboro emphasizes the fact that the new features are principally refinements, for better appearance and closer control. The Model 30 appears in the new universal rectangular case. When panel-mounted, the instrument extends only ¾ inch from the panel surface. The door is recessed; hinges and hasp are flush with the door surface. A dual pressure indicator, replacing the customary two small gauges, is easily seen through a rectangular opening in the door.

All operating adjustments are made from the front of the case, the adjusting mechanisms for change of control point, throttling range, and reset resistance being immediately accessible when the door is opened. The entire operating mechanism is protected and concealed behind a removable plate.

Operating features of the new controller are described in connection with the instrument's three functions: The first is its proportional function, providing uniform pneumatic proportional action. The reset function, the secondary adjustable controlling function, acts simultaneously with the proportional function, establishing stabilization at the desired point of control. The third function provides a temporary additional correction, determined by the rate of change in any disturbance of conditions. The operation of this third function is entirely automatic, being governed by the proportional and reset adjustments.

BELT VULCANIZER

Change in design of its No. 28 belt vulcanizer, to allow greater service, is announced by The B. F. Goodrich Company, Akron, Ohio. The No. 28 vulcanizer is now made with a square instead of a diagonal end, making it possible to cure wider belts. Widths of 34 inches can be cured with the vulcanizer placed at right angles across the belt. By placing the vulcanizer at an angle of approximately 22 degrees, a 28 inch belt can be cured, at an angle of 30 degrees, a 24 inch belt and at a 45 degree angle, a 16 inch belt.

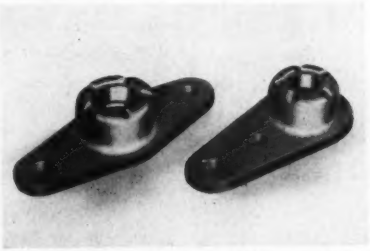
The new design has a platen 11 inches by 36½ inches, overall length of 41 inches, overall height 23½ inches and weighs 380 pounds complete with sheet iron platen covers, curing pad and two 25 foot lengths of extension cord.

The new design is listed as "Square End No. 28" while the older design, was known as "Diagonal No. 28."

ANCHOR TYPE ELASTIC STOP NUTS

Following the successful use of their anchor type nuts in aircraft construction, Elastic Stop Nut Corp., Union, N. J., is now offering these nuts for blind-mounting applications on general industrial equipment. Designed to provide vibration-proof fastenings for removable plates used to cover hand holes, access and inspection openings, and for other blind mount attachments, anchor nuts are permanently riveted to the inside of the structure. The bolts, which are inserted from the outside, pass first through the removable plate, thence through the structure into the stationary nuts.

These nuts are offered in a wide range of size, material, and thread system, every nut incorporating the basic Elastic Stop self-locking feature, a fiber locking collar which is an integral part of each nut. In such mountings, the bolts may be removed and replaced many times, the anchor nuts retaining their locking ability because of the resilent character of the fiber collar.



LIGHT WEIGHT SANDBLAST GUN

A light weight, sandblast gun suitable for decorative work, and for creating attractive permanent signs on plate and structural glass, is being manufactured by the Paasche Airbruch Co., Chicago, Ill. The gun is 5¾" long and weighs only 15 oz. with pint abrasive container. It operates on ¼ h.p. air compressor or larger, and handles such materials as aluminum oxide, silicon carbide, steel grit, etc., or 30 to 70 mesh.

CATALOGS RECEIVED

B. F. Goodrich Company, Akron, Ohio. The first of a series of six pamphlets on "How to Get the Most Service Out of Industrial Rubber Products". The series is designed to assist in the program of rubber conservation now made necessary by war developments.

American-Marietta Co., Chicago, Ill. The Valdura Paint Selector. A new handy means of selecting the best paint without detailed technical study of properties of all finishes that might be suitable for a given application. It lists information on properties and applications.

Jeffrey Manufacturing Co., Columbus, Ohio. Catalog 765, "Jeffrey Equipment for the Process Industries." A 20 page catalog listing briefly information on feeders, conveyors, elevators, processing equipment, screens, crushers, chains and sprockets, power transmission machinery, and portable units for loading and unloading operations.

Pittsburgh Plate Glass Co., Pittsburgh, Pa. "Glass and Its Adaptability to Modern Needs." A brochure that was prepared at the suggestion of the Division of Substitute Materials of the O.P.M. The brochure enumerates some of the flat glass products with a short description of each, together with availability information and properties and a suggested list of uses.

Bailey Meter Co., Cleveland, Ohio. Bulletin No. 16, "How to Safely Stretch Steaming Capacity". This bulletin, which is really a check list of procedure for boiler room improvement, also explains how the proper use of metering and control equipment stretches steaming capacity.

Wheelco Instruments Co., Chicago, Ill. A 6 page bulletin, "Defense Bulletin No. 1", has been issued to aid industrial instrument users in defense and non-defense industries to gain maximum life and efficiency from pyrometric equipment now installed and being installed.

Reeves Pulley Co., Columbus, Ind. Booklet No. G-423, "More Output For Defense". This booklet illustrates and describes numerous uses and applications for Reeves variable speed control equipment in defense industries and plants on many different types of machines.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite)			
90%, 99% through 200 mesh	ton	....	....
Precipitated material		55.00	60.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00–16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)			
Granulated	In bulk, ton	42.50	....
Granulated	In bags, ton	46.00	57.00–62 00
Powdered	In bags, ton	51.00	62.00–67.00
Boric acid (H_3BO_3)			
Granulated	In bulk, ton	96.50	
Granulated	In bags, ton	100.00	112.00–117.00
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland			
(Kryolith)	lb.	.950–.975	.10
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00–13.25	
40 mesh	ton	11.50–13.75	
Granular	ton	11.75–14.00	
Semi-granular	ton	11.00–13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.			
Fluorspar (CaF_2) domestic, ground, 96–98% (max. SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	34.00	....
In bags	ton	36.40	50.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0900	....
In 5 Ton lots	lb.	....	.0950
Less than 5 Tons	lb.	....	.10
Lime—			
Hydrated ($Ca(OH)_2$–MgO) (in paper sacks)	ton	8.50	8.50
Burnt (CaO–MgO) ground, in bulk	ton	7.50	....
Burnt ground, in paper sacks	ton	9.50	9.50
Burnt, ground, in 280 lb. drums	Per drum	2.35	2.35
Kiln Dried ($CaCO_3$-$MgCO_3$) 10x30 mesh	ton	2.00	....
Kiln Dried ($CaCO_3$-$MgCO_3$) 16x20 mesh	ton	2.00	....
Nepheline Syenite, f. o. b. shipping point	ton	13.00	16.50
Potassium carbonate—			
Calcined (K_2CO_3) 96–98%	lb.	.065	.0675
Hydrated 80–85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	21.00–22.00	28.00–30.00
in bulk		17.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	.95	....
In barrels	Per 100 lb.	1.35	....
In Paper bags	Per 100 lb.	1.10	....
In Burlap bags	Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	Per 100 lb.	....	3.00–3.40
95% and 97%			
Bulk	Per 100 lb.	1.35	3.60-4.00
200 lb bags		1.4675	1.48
100 lb. bags		1.475	1.50

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.031–.034	.045
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.15	.15½–16½
Arsenic trioxide (As_2O_3) (dense white) 99%		....	.05–.10
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)	lb.	....	12.50
Tin Oxide (SnO_2) in bbls	lb.	....	Open price
Titanium Oxide (ceramic grade) (Priority)			
In bags	lb.	....	....
In barrels	lb.	....	....
Zinc Oxide (ZnO)			
American process, bags	lb.	.07¼	.07½
White Seal, 150 lb. bbls	lb.	.09¾	.10
Green Seal bags	lb.	.09	.09¼
Domestic White Seal bags	lb.	.09½	.09¾
Red Seal, bags	lb.	.08½	.08¾
Zircon			
Refined Granular (Milled .01–.02c. higher)		.06½	.07–.08

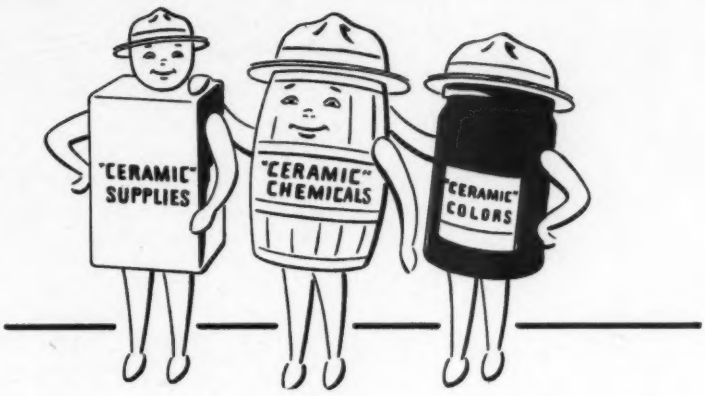
Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40–1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.10–1.15
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls	lb.	....	.25–.28
Chromite (99% through 200 mesh)	ton	58.25	64.75
Chromite ore (air floated)	ton	58.25	64.75
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.20–.22
Black (CuO)	lb.	....	.19–.22½
Black prepared	lb.	....	Open price
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.06–.10
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035–.05
Lead Chromate($PbCrO_4$) in bbls	lb.	....	.16½
Lithium Carbonate	lb.	....	1.25
Manganese, Black Oxide (Caucasian)			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	35–.40
Nickel monoxide (NiO), green	lb.	....	.35–.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.09½	.09¾–.10
Powdered	lb.	....	.10¼–.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21–.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07¼	.07½–.07¾
Sodium chromate (Na_2CrO_7) Anhydrous	lb.	.08⅝	.08⅞–.09¼
Sodium selenite (Na_2SeO_3)	lb.	....	1.50–1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.65
Yellow	lb.	....	1.65
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.40	3.75–4.15
Flowers, in bags	Per 100 lb.	3.05	3.40–3.80
Flour, heavy, in 250 lb. bags	Per 100 lb.	2.95	3.30–3.70
Uranium oxide (UO_2) (black, 96% U_2O_6) 100 lb. lots. Black	lb.	....	2.55
Yellow orange	lb.	....	1.65

Polishing Materials

		Carlots	Less Carlot
Emery, Turkish	lb.	.075	.08
Pumice Stone,			
American Ground FFF, FF, F	lb.	.03	.04
0, 0½, ½, 1	lb.	.05¾	.05¾
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	.02¼	.03½
Rouge, Red	lb.	.18	.16
Black	lb.	.15	.18

We're in the Army Now!



Serving as First Class Privates with a Specialist Rating.

Yep, "Ceramic's" number came up—along with the number of the ceramic industry as a whole. As usual the ceramic industry is cooperating and backing the "all-out effort for the duration" one hundred per cent.

This "all-out effort" will place many restrictions upon all of us. Till the war is over, the ceramic industry will have to use all the ingenuity and "imagineering" at their command to meet changing conditions. You should be aware, however, that many of the colors, chemicals and mill room supplies have not been affected by war needs. These "CERAMIC" materials are still yours and we would be glad to tell you just what they are.

We ask that you remember, however, that you are not alone in your research for broader use of old materials, for substitutes, and for new materials. "Ceramic" research men and facilities are also busy.

With the two of us working together, in good old American-pioneer style, we are sure that your ceramic problems and requirements can be met successfully.

Let us know your particular requirements.

"Ceramic" COLORS
CERAMIC COLOR & CHEMICAL MFG. CO.
NEW BRIGHTON, PA., U.S.A.

YOUR

GLASS MANUFACTURING

PROBLEMS ARE

OURS

. . . ours in the sense that we feel we can be of genuine service to you . . . ours in the sense that your problems are held in the strictest confidence, both by our organization and by our men who work with you.

Solvay Technical Service is composed of men who can give you more than mere opinions. You will find that their reports contain sound, well-thought-out solutions to your problems . . . solutions which could only be based on practical knowledge gained through years of specific experience in your field.

We would like you, as a glass manufacturer, to make the utmost use of Solvay Technical Service . . . to get the benefit of a competent, outside viewpoint on your glass manufacturing problems, especially as they relate to the use of alkalies. When problems arise, please do not hesitate to write us. Write to the nearest Solvay Office listed below.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET NEW YORK, N. Y.

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SOLVAY

TRADE MARK REG. U. S. PAT. OFF.

TECHNICAL SERVICE

REPLACEMENT OF OXYGEN IN GLASS

(*Continued from page* 137)

*$Si S_2 + 2H_2O = SiO_2 + 2H_2S$

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[20]N. Kreidl and W. A. Weyl. Phosphate Glass. Journ. Amer. Cer. Soc. **24** (1941) 372-378.

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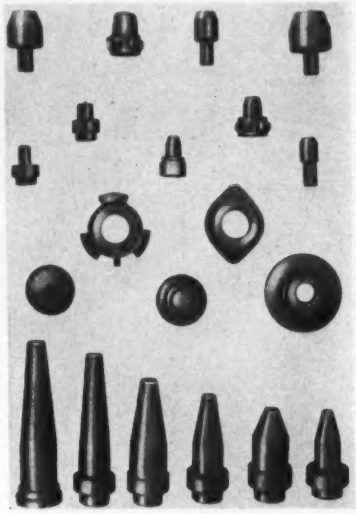
Julian H. Toulouse, formerly Chief Service Engineer, General Manufacturing Department, Owens-Illinois Glass Company, Toledo, has recently been appointed Chief of the Glass Containers and Closure Section, which functions as part of the Containers Branch of WPB.

BULB SUIT POSTPONED

Federal District Judge Philip Forman, overriding objection by Government counsel, March 18 postponed until April 13 opening of an anti-trust suit in Trenton, N. J., against 12 major light bulb industry firms to allow "thorough exploration of possibilities for a formula for effecting a settlement of the litigation satisfactory to all parties concerned."

GUNITE

Serves



WITH the unprecedented demands which are being made today on the metal producing industries naturally Gunite Foundries Corporation has become engaged to a considerable extent in the production of castings to meet the many and varied needs of our war effort. And we are proud of the part which we are permitted to play in contributing to ultimate victory for our Allies and ourselves.

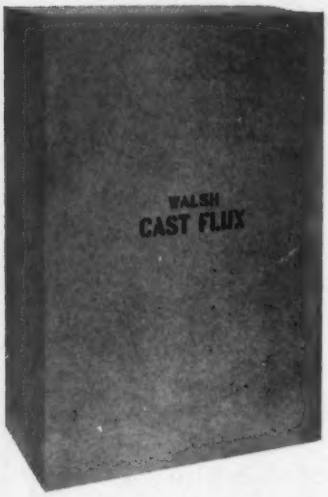
Metallurgical research and the highest efficiency in foundry practice have been the basis of Gunite's prestige and success in the foundry field. Coupled with these inherent qualities a greatly expanded productive capacity enables us to not only effectively contribute to our war effort but also to continue to offer unimpaired service and castings of the highest quality to the glass manufacturing industry.

Gunite Foundries has developed a metal for every type of glasshouse casting. Miller plungers and guide rings, neck ring sticks, bushing stock, press and blow moulds. If you have a specific problem our experience in glass mould equipment should be of value to you. Write us if you think we can help.

GUNITE FOUNDRIES CORPORATION

ROCKFORD - - - - - ILLINOIS

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street

St. Louis Missouri

L-O-F TO FABRICATE PLEXIGLAS

Again broadening production facilities to further assist the government in its war program, Libby-Owens-Ford Glass Company has announced it will fabricate Plexiglas transparent plastic parts for aircraft, under an agency agreement with Rohm & Haas Company, pioneer chemical manufacturers of Philadelphia, Pa. Fabrication work, to start soon, will be centered in the Toledo area, and in supplementing the Rohm & Haas production facilities should contribute substantially to the urgent need for speeding up military aircraft output.

In cooperating with the Rohm & Haas plants in Philadelphia and Los Angeles, L-O-F will serve the large and expanding aircraft industry in Ohio and Michigan. R. G. Milroy, for many years manager of the company's automotive safety glass sales in Detroit, will remain there to supervise Plexiglas marketing.

The arrangement to fabricate Plexiglas enables L-O-F to return to its payrolls additional employees affected by the automotive industry's switchover to military production. The company explained that it could not accurately determine at this time how many men the new Plexiglas operations in the Toledo area will involve, but it expects to begin on a modest scale with the hope that the number of men employed will increase as the aviation industry reaches full production.

CONDENSED CHEMICAL DICTIONARY—THIRD EDITION

A reference volume for all requiring quick access to a large amount of essential data regarding chemicals and other substances used in manufacturing and laboratory work. This third edition has been completely revised and enlarged under the supervision of Thomas C. Gregory.

In the third edition, the general arrangement which was so successful in the second edition, remains the same, but with the addition of over 6,000 new items. They comprise chemicals, drugs, pharmaceuticals, chemical specialties, and many others. Also, many new encyclopedic-type definitions have been added. The old items carried over from the previous edition have been brought up to date. One valuable feature is the large number of chemical specialties sold under trade or brand names, included in the present edition. Another feature is the inclusion of typical specifications. Data on labeling in accordance with railroad shipping regulations is a feature which has also been retained. Many data, formerly regarded as confidential, and confidential data respecting many new chemicals about to be placed on the market were supplied by leading chemical manufacturers.

The book, published on February 10, may be obtained from *The Glass Industry*. The price is $12.00.

• The Overmyer Mould Company, Winchester, Ind., has recently purchased a plot of ground of about 7 acres in Winchester for the purpose of erecting a new factory building. Preparations for grading the ground are being made now, but the building plans have not been completed. It is not definitely settled at this time as to which branch of the company will be operated in the new building.

Diamond Soda Ash

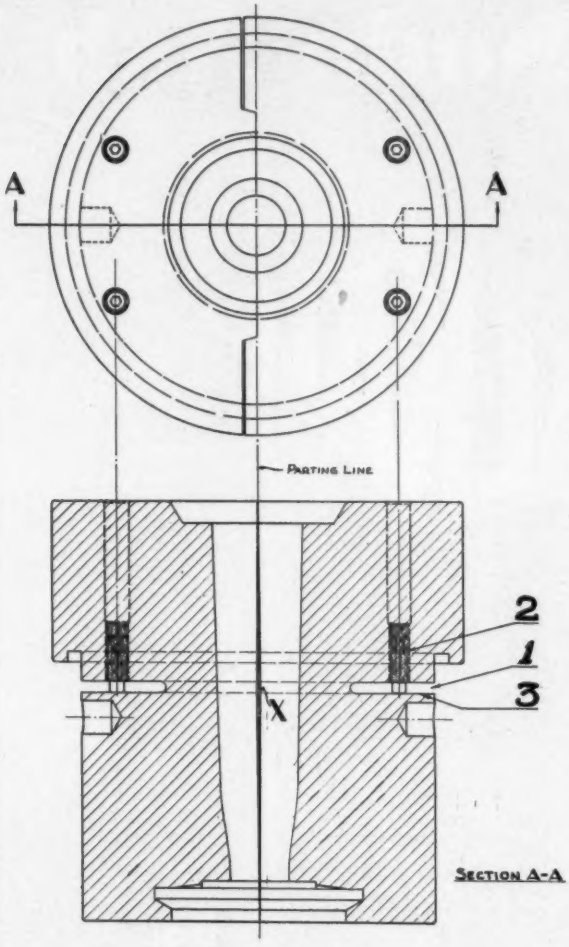
where purity and uniformity are required

DIAMOND ALKALI COMPANY

PITTSBURGH, PA., *and Everywhere*

PRE-STRESSED MOLD WALLS AIMED AT OVERCOMING HEAT WARPING

Otto H. Samuelson of Indianapolis is reported to have had much success in preventing the warpage of molds by a new pre-stressing system which can be applied to blank molds including those of various continuous bottle machines. The warping of iron molds is a familiar problem for which many solutions have been tried, including special heat treatment of the molds. Warping is caused by the greater expansion of the inside surface of the mold due to heat absorbed from the glass. Since the outside remains cooler, the inside surface will have a greater comparative expansion and will tend to bow out, so that the two half sections of the mold stand apart, along the parting line, at the top and bottom. As the molds warp and separate, the blank cannot keep the finish ring closed tightly. This tends to produce big seams and off-gauge finishes.



Speed of operation has a lot to do with this condition since the molds will run hotter as the production rate is stepped up. To overcome these problems Mr. Samuelson devised the control method herewith illustrated. One or two grooves (1) are cut in the mold at the proper places. The fine thread screws (2) are used in this case so that a fine adjustment may be had. Pressure is applied against shoulders (3) by turning these screws (2) to bow, bend, or spring each half of blank inward at the top and bottom to the desired amount, thus creating an opening (X) in the center of the blank. As the blank becomes hot the arrangement makes it possible for the expansion to take place and the faces of the blank will make contact the entire surface from top to bottom.

Mr. Samuelson's experience indicates that after the correct adjustment has once been made, the molds can be put back in operation many times without readjustment. However, a change can be made if the speed of the machine or other controlling factors are altered.

Patents for the U. S. and Canada have been applied for.

RECRUITING FOR TECHNOLOGISTS

About a year ago the Federal Civil Service Commission began a recruiting drive for technologists. The number of persons on the employment lists now established is not sufficient for today's wartime needs. Accordingly, the Commission has recently reissued the announcement of these opportunities for Government employment with slightly modified requirements.

For the Junior positions ($2,000 a year), applicants will not longer have to take a written test and, as before, no written test will be given for the higher positions. The maximum age limit for all the grades has been raised to 60 years.

Copies of the announcement (No. 188), and the forms for applying, may be obtained at first and second-class post offices, or from the Civil Service Commission, Washington, D. C.

FLUXTITE by LACLEDE-CHRISTY

. . . the tank block of accurate structure balance made by ceramic experts from a precision blend of fire clays, including the famous Missouri Washed Pot Clays.

Fluxtite and its companion products, Laclede's Super Refractory Mix 89 and Laclede's Refractory Upperstructure, have been and are now meeting the strict requirements of the producers of soda-lime, boro-silicate and all other glasses.

Laclede-Christy, "The Glass Industry Specialists," have everything in refractories for the glasshouse. Consult with . . .

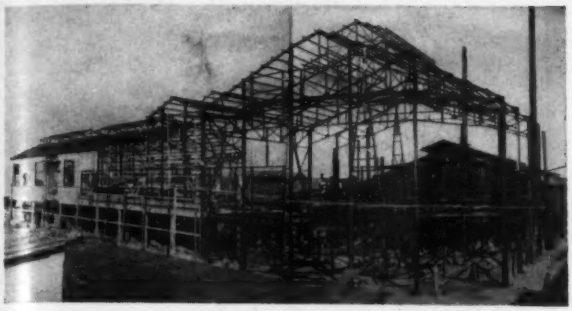
LACLEDE-CHRISTY

The World's Largest Producers of Glass House Refractories

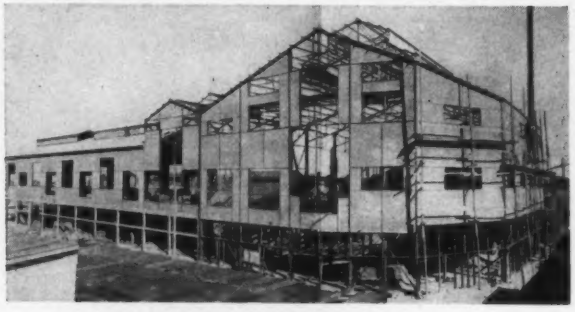
ST. LOUIS . . TOLEDO

GLASSHOUSE ENGINEERING

from the breaking of ground to the making of glass.



Factory Under Construction

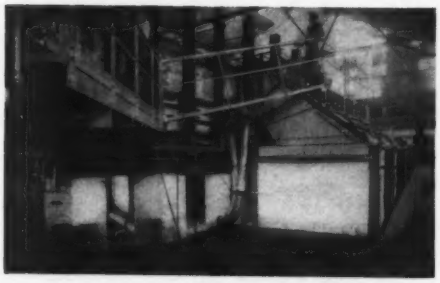


Factory Nearing Completion

Charging End of Oil Fired Tank Furnace

Charging End of Oil Fired Tank Furnace

Nose End of Tank Furnace Container Ware



Feeder End of Tank Furnace Container Ware

Outside View of Pot Furnace for Table Ware

Inside View of Pot Furnace for Table Ware

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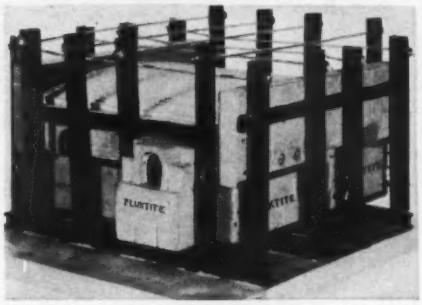

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